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ABSTRACT

To gain some insight into the problem of deviant speech development in low income populations, this study investigated the environmental factors that encourage the development of normal speech. Two specific questions were examined in this study: (1) If specific vocalized environmental sounds are presented contiguously with reinforcement, will subject vocalizations of that sound increase? and (2) Would establishing specific environmental sounds as discriminative for reinforcement produce increases in subject vocalizations of those sounds? Subjects were a 13-month-old female and a 10-month-old male. Experimental manipulations involving recording of environmental sounds and a stimulus presentation tape established the conditions in question: specific vocalized environmental sounds presented contiguously with reinforcement and specific environmental sounds established as discriminative for reinforcement. Findings indicated that, for these subjects, pairing sounds with reinforcement produced no effects on rate of vocalization of these sounds, but that making these sounds discriminative for reinforcement did increase subjects' rate of vocalization. (MH)

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AN EXPERIMENTAL ANALYSIS OF PROCEDURES FOR INCREASING[1] SPECIFIC VOCALIZATIONS OF CHILDREN WHO DO NOT DEVELOP FUNCTIONAL SPEECH

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ABSTRACT

Three environmental functions were proposed as being included in most learning theory accounts of the development of speech from the random vocalizations of human infants: 1) Pairing environmental vocalized sounds with reinforcement; 2) Establishing environmental vocalized sounds as discriminative for reinforcement; and 3) Differentially reinforcing infant vocalizations which approximate environmental vocalized sounds. Four questions were raised regarding these environmental functions: 1) If specific vocalized environmental sounds are presented contiguously with reinforcement, will subject vocalizations of that sound increase? 2) Would establishing specific environmental sounds as discriminative for reinforcement produce increases in subject vocalizations of those sounds? 3) Would shaping imitative vocal responses to environmental sounds other than those being tested produce changes in the vocalization rate of those being tested? and 4) If imitative vocal responses of the specific environmental sounds being tested were shaped, would this produce increases in the rate of those vocalizations during baseline conditions? Experimental manipulations were effected to answer the first two of these four questions. The results indicated that pairing sounds with reinforcement produced no effects upon the subjects' rate of vocalization of these sounds. Making these sounds discriminative for reinforcement did, however, increase the rate of vocalization of these sounds. Future studies to answer questions three and four were discussed.

There is a high incidence of deviant, late, and/or non-development of speech in low-income populations. Presently, little is known regarding how children

acquire adequate speech. There is, however, much theoretical speculation regarding speech development in the infant which may or may not be relevant to the actual acquisition process. An analysis of these theoretical processes would indicate those procedures which are sufficient for increasing specific vocalizations of the infant, thus lending information regarding possible acquisition processes. It would also produce information regarding those procedures which may not be sufficient for producing such increases in specific vocalizations, thus discounting those theoretical speculations which are not adequate for accounting for the process of speech acquisition. If these procedures can be isolated, it would also be possible to develop more efficient and effective programs for establishing adequate speech in those children for whom the language process doe not "naturally" evolve.

Most learning theory accounts of the development of speech from random vocalizations of human infants consider that at least one (or even two or more) of three environmental functions play a part in this development. These environmental functions are: 1) Pairing environmental vocalized sounds with reinforcement, 2) Establishing environmental vocalized sounds as discriminative for reinforcement, and 3) Differentially reinforcing infant vocalizations which approximate environmental vocalized sounds.

In Mowrer's (1960) two-factor theory of speech development, the basic condition for word learning was the temporal contiguity of word sounds and reinforcement occurring in the environment. He concluded from his work with Parront (1950) that sounds must be associated with reinforcement for talking birds to imitate them. He and Risley (1965) essentially agree on this prerequisite of pairing environmental words with reinforcement for the development of speech. Both further postulate that the acquired reinforcement properties of environmental words are transferred to those infant vocalizations which imitate the environmental sounds. These propositions have been somewhat supported by the work of Kelleher

and Gollub (1962) and Lovaas, et al. (1965) who established previously neutral stimuli as conditioned reinforcers, through pairing the stimuli with primary reinforcers and through the removal of primary negative reinforcers respectively.

However, Dinsmoor (1950) had hypothesized the necessity for establishing a stimulus as discriminative for reinvorcement before it would acquire conditioned reinforcement properties. Zimmerman (1959) demonstrated that a previously neutral stimulus, which was made discriminative for reinforcement, became a conditioned reinforcer and that the presentation of the acquired reinforcer increased response rates. Lovaas, et al. (1966), also demonstrated this effect by establishing social reinforcers for schizophrenic children through making the social stimuli discriminative for reinforcement. He further reported a failure to establish the social stimuli as reinforcers when pairing the stimuli with food without prior discrimination training.

It becomes increasingly clear that determining through what process a previously neutral stimulus acquires reinforcement properties is, as yet, unresolved. However, both the Risley and Mowrer theoretical accounts assume the occurrence of this phenomenon in the development of speech through temporal contiguity of sound and reinforcement. Therefore, an adequate experimental test of these theories would require a demonstration of both the conditioned reinforcement properties of the auditory stimuli which were paired with reinforcement and those of the vocalizations imitating these stimuli. Additionally, if it were demonstrated that these vocalizations had acquired conditioned reinforcement properties, it would be necessary to determine through what process they had done so.

Foss (1964) attempted a test of Mowrer's theoretical position of the development of speech with Myna birds and concluded that differential pairing of reinforcement with sounds did not determine which sound the birds would imitate. However, there was no test applied, prior, during or following the experimental

procedures, to determine whether the sounds, or the birds' vocalizations of them, had acquired conditioned reinforcement properties (an essential ingredient of Mowrer's theory). Zimmerman (cited in Mowrer, 1960) also attempted to test Mowrer's theory, using dogs' own recorded barkings as the stimuli paired with reinforcement. However, Zimmerman's study also provided no test to determine if the recorded barkings paired with reinforcement had actually become conditioned reinforcers. Therefore, Mowrer's theoretical account of speech development cannot be discounted on the basis of these two studies.

Risley and Mowrer further agree that it is through the acquired reinforcement properties of specific environmental sounds that infants are intrinsically reinforced when their vocalizations approximate these sounds. Mowrer, however, requires a deprivational state of the specific reinforcer previously paired with the environmental sound to motivate the infant to imitate that sound. On the other hand, Risley points to the need for an underlying system of general reinforcement of all infant vocalizations to maintain a vocalization rate upon which a system of "autistic" (intrinsic) reinforcers are superimposed to control successive approximations toward imitation of those environmental sounds previously paired with reinforcement. There is some evidence that vocalization rate of infants can be increased and maintained through reinforcement.(Rheingold, et al., 1959; and Weisberg, 1963). However, the effects of such increased vocalization on the development of speech remains an empirical question.

In addition to his "autistic" account for the development of imitative speech, Risley also includes two other subclasses of imitation (discriminated and generalized) in his proposed sequence of conditions which can account for the development of verbal behavior. Discriminated imitation includes those imitative responses which are reinforced only in the presence of specific environmental stimuli, such as "Say.....", or "Do this", etc. Generalized imitation is a

response class whose rate is maintained by an increased probability of reinforcement for this behavior which is produced by the effects of the imitative behavior on persons or objects. Baer, et al., (1967) demonstrated that a generalized imitative response class could be established through initially bringing the subjects' responses under the instructional control of the experimenter's demonstration and then introducing other models for imitation which had not previously been reinforced. A possible account which they purported for the development of widely generalized imitative repertoires was the acquired reinforcement properties of behavioral similarity between subject and model. It seems equally plausible within their design that the maintenance of the nonreinforced imitative behavior could also be accounted for through intermittent scheduling of reinforcement.

Though it appears that imitative behavior can, at least in part, account for speech development, it is not clear 1) whether each imitative response must be differentially reinforced or whether a general imitative response class can be established and 2) whether the establishment of such a response class is based upon the phenomena of the acquired reinforcement properties of behavioral similarity.

In view of the foregoing discussions, four questions regarding the three environmental functions listed initially as contributing to the development of speech can be asked.

1. If a vocalized environmental sound is presented contiguously with reinforcement, will the vocalization of that sound by the subjects increase, remain the same, or decrease.
2. If the contiguous pairing procedure produces no changes as described, would establishing that sound as discriminative for reinforcement produce vocalization rate changes of that sound.

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3. If neither of the first two procedures (#1 and #2) produce changes as described, would establishing a general vocal imitative repetoire to sounds other than those being tested produce these changes.
4. If none of the above procedures (#1, #2, and #3) produces the described changes, would shaping imitative responses to the specific sounds being tested establish these changes.

The present study effected procedures to answer only the first two of these four questions.

METHOD

Subjects

The subjects were two toddlers, one female (Subject 1) who was 13 months at the outset of the experiment and 18 months at termination of experimental sessions, and one male (Subject 2) who was 10 months at outset and 13 months at termination. The subjects were chosen because they were emitting random vocalizations but had no apparent functional speech. However, at the termination of experimental sessions both subjects were emitting some functional speech such as "Hi", "Momma", and "Kitty". If the subjects emitted any of these functional words during experimental sessions, they were not counted as random vocalizations.

Apparatus

Two tape recorders were used throughout the experiment. One was used to tape all experimental sessions, from which the observers subsequently counted the subjects' vocalizations. From these tapes, two specific low-to-moderate-rate vocalizations of each of the subjects were isolated and taped onto a stimulus presentation tape. These two vocalizations were randomized and taped at variable intervals of 8". This stimulus presentation tape was played on the second tape

recorder during the experimental manipulations. No sounds were presented during any baseline manipulations.

Procedures and Results

The kitchens in the homes of the respective subjects were used as experimental rooms. The subjects were seated in high-chairs next to a table at which the experimenter was seated. The experimental sessions for Subject 1 were held at approximately 11:30 a.m., five days a week and for Subject 2 at 4:30 p.m. seven days a week. Reinforcement consisted of the experimenter saying "Good", "That's Good", "Fine", or the equivalent and giving the subject a small bit of food. The experimenter's verbal reinforcers were varied to avoid increasing the possibility of the subjects imitating the words of the experimenter. The food for reinforcement was prepared prior to the session by the mothers of the subjects. It was necessary for the experimenter to arrange the tape recorders in the kitchens during this preparation. Subject interest in the recorders was discouraged by placing them out of sight behind the subjects' high-chairs.

Pre-experimental sessions for Subject 1 and five pre-experimental sessions for Subject 2 were conducted for each subject in order to gradually change the baseline reinforcement requirement from CRF to VR 8 for Subject 1 and from CRF to VI 5' for Subject 2. These schedules were contingent upon any vocalizations emitted by the subjects during the baseline period regardless of content. If, however, the subjects began to vocalize during this time, on a non-random basis, i.e., repeating the same vocalization over and over, reinforcement was not delivered until the subject emitted a sound other than the one for which he was previously reinforced. Withholding of reinforcement was necessary only two or three times for each subject.

During the pre-experimental and baseline sessions, four vocalizations of Subject 2, (a) "e", (b) "e", (c) "uh", and (d) "ah", were isolated for purposes

of future manipulation and control. The vocalizations isolated for Subject 1 were (a) "e", (b) "ah", (c) "ah", (d) "eh", and (e) "uh". Sounds labeled (a) and (b) were near-zero in vocalization rate for Subject 2 and low to moderate in rate for Subject 1. Therefore, these sounds were chosen for experimental manipulation. The other vocalizations listed were also recorded during the baseline periods for purposes of control comparison.

Observer agreement for counting total vocalizations, on a rate-per-minute basis, ranged from 90 to 95 percent; agreement for the specific vocalizations ranged from 75 to 95 percent. This agreement was computed by dividing the total vocalizations or the total of the specific vocalizations by the number of minutes per session and comparing these rate measures between observers.

Sounds (a) and (b) of each subject were used for recording the randomized sounds, on the VI 8" stimulus presentation tapes. Therefore, the tapes presented during experimental manipulations were the actual vocalizations of each subject respectively. One clear and isolated vocalization of each sound to be presented was chosen from the subjects' pre-experimental and baseline sessions. Each of these sounds was repeatedly recorded to make the randomized VI tape consisting of 30 episodes of each sound. Therefore, during experimental manipulations, the sounds heard by the subjects were controlled in terms of intensity and comparability. Using the subjects' own vocalizations for the stimuli also precluded any question of their "ability" to emit the sounds presented to them.

Baseline

Following the pre-experimental sessions, ten baseline sessions were recorded for each subject. During these sessions, all vocalizations of Subject 1 were reinforced on a VR 8 schedule (range 3- 13) and subject 2's were reinforced on a VR 5 schedule (range 1 to 9). Each baseline session was approximately 9 to 12 minutes long.

After the onset of the experimental manipulations, the sessions consisted of six minutes of the experimental manipulation and approximately six minutes of the baseline conditions. This procedure allowed immediate analysis of the effects of the experimental manipulations upon the subjects' rate of vocalization of the specific sounds being manipulated.

Manipulation 1 (with subject 1 manipulations one and two were reversed in order)

To test the effects of pairing a sound with reinforcement upon the vocalization rate of that sound by the subjects, the stimulus presentation tapes for each subject were presented for six minutes of the experimental session. Sound (a) for each subject was concomittently paired with the experimenter's verbal reinforcement and a bite of food. Sound (b) was presented with no experimental consequences. These sounds were randomized and presented on a VI 8" schedule via the second tape recorder. Following the six minute pairing condition, six minutes of the baseline condition occurred as described above. Neither Subject 1 nor Subject 2 showed any changes in rates of overall or specific vocalizations under this condition.

Manipulation 2

To determine the effects of making a sound discriminative for reinforcement upon the vocalization rate of that sound by the subjects, it was first necessary to, in fact, make that sound discriminative for reinforcement. It was decided to do this with sound (a) for each subject. Through all these procedures a baseline period as described above occurred each day along with six minutes of the experimental manipulation.

First, each subject was shaped to tap the tray of the high-chair in order to obtain reinforcement. This was done by the experimenter first tapping the subject's hand for him and then gradually fading out these physical prompts. For Subject 1 twelve sessions were necessary to establish and stablize this response. For Subject 2 eight sessions were necessary. The second tape recorder was then

turned on and when the subject tapped immediately subsequent to either sound (a) or (b) presented on the tape reinforcement occurred.

Since tapping did not, in fact, occur with frequency immediately subsequent to sounds within a weeks time, it was decided to dispense with the stimulus tape on the second tape recorder temporarily in order to bring each subject's tapping under more definite stimulus control. This was accomplished by shaping each subject to tap his hand only when the experimenter emitted the verbal prompt, "hit". This was shaped by, again, first tapping each subject's hand for him when the experimenter said "hit" and then reinforcing the subject. The physical prompt was then faded. Concurrently, if the subject tapped at times other than within 2" of the experimenter's saying "hit" the experimenter looked away from the subject and said nothing for four seconds. It took 8 sessions for Subject 1 and 4 for Subject 2 to demonstrate accuracy under this condition. Accuracy was judged as the subject tapping following "hit" at least 90% of the time spent in this manipulation.

Sounds (a) and (b) were now again presented via the second tape recorder and the experimenter paired the verbal prompt, "hit" with sound (a). Each subject maintained accuracy in tapping following the prompt so after 3 such sessions for Subject 1 and 1 session for Subject 2 auditory fading of the verbal prompt began. Although accuracy was maintained through the beginning fading it declined as the auditory prompt lessoned in volume. Accuracy could be reinstated by the experimenter returning "hit" to its original volume level but neither subject could adequately maintain responding when fading was begun. Twelve sessions with these conditions occurred for Subject 1 and 18 such sessions for Subject 2.

The last technique employed on both subjects involved physical rather than verbal prompting by the experimenter. The second tape recorder was turned on and each time sound (a) was presented the experimenter immediately tapped the subject's

hand for him and reinforcement was given. Both subjects did well when prompts were given and followed fading with fair accuracy (75-100%) through all steps including the experimenter simply motioning slightly downward with her own hand; however, when there was no prompting at all both subjects failed to demonstrate accuracy on tapping subsequent only to sound (a). With Subject 1 this entire procedure lasted 11 sessions; with Subject 2 it lasted 4 sessions.

At this point, Subject 2 was discontinued and the following techniques were employed only on Subject 1. The second tape recorder with its stimulus tape was again eliminated. The experimenter herself emitted sounds (a) and (b) for Subject 1 and the subject was reinforced for tapping subsequent to sound (a). The subject was not reinforced for tapping subsequent to sound (b) and this sound was presented again if tapping occurred subsequent to it. Physical prompting of tapping subsequent to sound (a) was again employed and, again, fair to good accuracy was maintained until prompting ceased, then accuracy ceased also. Seven sessions were run with these conditions.

The final technique used involved the experimenter first vocalizing only sound (a). The subject was reinforced for tapping subsequent to the sound. Within two sessions the subject demonstrated accuracy of 90% or better on such tapping with no prompting by the experimenter. After four sessions with this accuracy maintained the experimenter began randomly fading in sound (b). This sound was to be repeated if tapping occurred subsequent to it. However, accuracy ceased when fading sound (b) in got above the mouthing stage into a low whisper. After ten sessions using this method Subject 1 was discontinued.

It is proposed to begin a new subject and use the following method to make a sound discriminative for reinforcement. First, establish baseline and shape the subject to tap the tray of the high-chair as described above. Next shape the

subject to tap subsequent to the experimenter's vocalizing, for instance, sound (a). Fade in sound (b) and also reinforce the subject for not responding subsequent to it. Repeat sound (b) it tapping occurs subsequent to it. At this point, fading out of both these sounds begins and when fading has reached the whisper stage the sounds are presented at a low volume level via the second tape recorder. The volume of the stimulus tape on the second recorder is then gradually increased to normal volume as the experimenter's vocalizations are eliminated. Fading via the tape is then begun with sound (b) and, simultaneously, a third sound (also taken from the subject's baseline sessions), sound (c), is faded in to replace sound (b) on the tape. Reinforcement does not occur for not tapping subsequent to this third sound. It may be found necessary to reinforce at first for not tapping subsequent to sound (c). If so, reinforcement will then be faded out so that, in the end, the subject does, in fact, tap and get reinforced for tapping subsequent to sound (a) and not tap and not get reinforced for tapping subsequent to sound (c).